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EFFECT OF DIETARY YUCCA SHIDEGRIA EXTRACT (DEODORASE) ON ENVIRONMENTAL AMMONIA AND GROWTH PERFORMANCE OF CHICKENS AND RABBITS

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Abstract

Experiments with weanling rabbits and Leghorn replacement pullets were condusted to determine the effect of dietary Yucca extract (YE) on atmospheric ammonia and on performance. Both experiments were conducted in identical rooms of 4.9 x 4.9m floor space. Rabbit excreta were accumulated on a plastic sheet with sawdust bedding; the chicks had 10cm sawdust litter. Data were analyzed using SAS. In Expt. 1, New-Zealand White (NZW) weanling rabbits were assigned to 4 treatments: Control (C), C + 125mg (YE)/Kg diet, C+250mg YE/Kg and C+YE sprayed on excreta. There were 3 cage replicates per treatment, with 8 rabbits per cage. The trial period was 50 days. A second replicate was conducted with the excreta from the first replicate retained. Ammonia (NH_3) was measured 35cm above and below the cages with Drager diffusion tubes on days 7, 14, 21, 35, 40 and 50 in rep 1 and 1, 10 and 35 in rep 2. Average daily gain (ADG) and feed/gain for C, C+125 YE, C + 250 YE were : 27.7^a, 4.55^a; 36.0^b ,3.66^b ,36.7^b , 3.57b for rep 1 and 27.7a, 4.05^a, 33.5^b, 3.72, 33.0^b, 3.82^b for rep 2, respectively. Treatments showed significant at ($P<0.05$). NH3 levels (ppm) on day 50 (rep 1) for C, C+125 YE, C+250 YE above and below the cages were: 26, 30, 7, 13, 6, 9, respectively, while, rep 2 on day 35, NH3 levels were : 15, 24, 5, 5.5, 7.5, 8 respectively. In the chick trial, 500 Leghorn pullet day-old chicks per rep were used, with 2 treatments (C, C+125 mg YE/Kg) with 2 reps per treatment. NH3 was measured at weekly intervals for 6 weeks, at heights of 0.3, 0.9 and 1.5m. Growth was assessed by weighing 25 birds per pen at weekly intervals. After 6 weeks, body weight for C and C+YE were 349a and 395b, respectively (differences were significant at 5% probability). NH3 levels (ppm) for C and C+YE were 21.3a and 6.7b, differences were highly significant ($P<0.01$). It is concluded that, dietary YE, under the experimental conditions, reduced atmospheric NH3 in poultry and rabbit houses, and increased growth rate.

INTRODUCTION

As poultry industry allover the world has been adapted to confinement rearing, the accumulation of odorous gases like ammonia and hydrogen sulfide causes enormous damage to birds, as well as, to human welfare. Ammonia at certain concentrations (25 to 30 ppm) can irritate the eyes and throat in humans. Exposure of birds for a prolonged period of time to elevated ammonia concentrations from manure has been reported to cause Keratinconjunctivitis in Chickens (Bullis *et al.*, 1950), weight loss and lowered survival rate (Charles and Payne 1966), delayed sexual maturity, lowered feed consumption, decrease feed efficiency and lowered egg production (Petkov 1966, Goldhaft, 1969).

High ammonia levels in the air of confinement livestock facilities are important sources of discomfort and ill health for both animals and their care-takers. Ammonia is released by microbial action from nitrogenous excretory products such as urea and uric acid. Poultry and rabbit buildings are particularly subjected to high ammonia levels. Poultry excreta are very high in nitrogen (as uric acid), while rabbit's are high in urea nitrogen. In addition, water excretion of rabbits is very high, leading to high humidity, and high concentration of dissolved ammonia in water droplets. This dissolved ammonia is particularly damaging to the respiratory tract mucosa, causing high susceptibility to respiratory diseases. Morrisse (1979) and Patton *et al.* (1980) reported that, elevated environmental ammonia levels greatly increased the incidence of *Pasteurella multocida* infection and respiratory diseases in rabbits.

The Yucca plant, *Yucca shidegria*, contains glycosylated components (Lyons, 1991) which bind ammonia (Headon, 1991). Yucca extract (YE), when used as a feed additive has been reported to bind ammonia in livestock and poultry excreta, and to reduce environmental ammonia (NH_3) levels (Johnston *et al.*, 1981; Headon, 1991 and Ismail *et al.*, 1996a, b).

The objective of this study was to evaluate the effect of dietary YE on NH_3 levels in confinement rabbit and poultry facilities, and to determine if YE influences performance parameters such as growth rate.

MATERIALS AND METHODS

Experiment 1. The effect of YE on growth performance of rabbits and environmental NH_3 levels was examined in two sequential trials. In trial 1, 96 New-

Zealand white (NZW) weanling rabbits of 5-6 weeks of age were assigned in equal numbers to 4 treatments: Control (C), C + 125 mg YE/Kg diet, C + 250 mg/kg diet and C+YE sprayed on excreta. There were 3 cage replicates per treatment with 8 rabbits per cage. Each treatment was set up in a separate room in a broiler house containing a series of identical rooms of dimensions 4.9m x 4.9m. The wire rabbit cages were suspended over a plastic sheet, a height of 1.5 m, on which all excreta were collected. A layer of wood shavings was placed on the plastic sheet before the experiments had begun. The excreta were not physically disturbed throughout the two trials.

The composition of the control diet is shown in Table 1. Animals were provided feed and water ad *libitum*. The YE spray solution contained 125 mg YE/1, to provide 1.5g YE per m2. The excreta were sprayed 24 h before NH3 readings were taken. Air NH3 measurements were made with Drager 8-h diffusion tubes. The tubes were placed on equal distances (35 cm) above and below the center cage in each battery of three cages, for 8-h, on days 7,14, 21, 35, 40 and 50 of the experimental period. The trial lasted 50 days. Dead animals (two only) were replaced to keep the same stocking density.

Table 1. Composition of the rabbit control diet.

Ingredient	%
Alfalfa meal (sun cured) (20%)	56.50
Wheat mill run (15.7%)	37.00
Meat meal (50%)	0.80
Molasses (7%)	3.00
Bentonite	1.25
Salt (trace mineralized)	0.50
Vitamin premix	0.95

Calculated chemical analysis for rabbit's diet: CP% 16.64, DE 2773 Kcal/kg,

A second replicate was conducted using the same facility and treatments. The excreta from the first replicate were left undisturbed on the plastic sheets, and the second replicate started as soon as the first was completed. NH3 measurements were made on days 1, 10 and 35.

Experiment 2. The objectives were to determine the effect of dietary YE on

air NH3 in a poultry facility, and the effect of YE on bird performance. Leghorn replacement pullet chicks were assigned to each of 4 identical rooms of 4.9 x 4.9m, with 500 chicks per room. Two rooms were assigned to each diet: control (Table 2) and control + 125 mg YE/kg diet. Litter in the pens consisted of clean wood shavings at a depth of 10 cm. The experimental period lasted 6 weeks. At weekly intervals, 25 birds were randomly selected from each pen and weighed. Air NH3 measurements were taken at weekly intervals with 8 h Dragger diffusion tubes.

Table 2. Composition of the chick starter control diet.

Ingredient	%
Yellow corn (8.5%)	66.68
Soybean meal (48.5%)	25.62
Meat and bone meal (50%)	5.0
Monocalcium phosphate	1.0
Limestone	1.0
Salt	0.4
* Trace mineral premix	0.05
** Vitamin premix	0.20
Dl-methionine	0.05

Calculated chemical analysis for chick's diet: CP% 20.62, ME 2968 Kcal/kg.
* Each Kg minerals contained: Choline chloride 240 mg, Mn 1700 mg, Zn 1400 mg, Fe 1500 mg, Cu 600 mg, Se 20 mg, I 40 mg and Mg 800 mg.
** Each kg vitamin contained Vit. A 2, 000, 000 IU, E 10, 000 mg, D3 180, 000 IU, K3 400 mg, B1 400 mg, B2 1200 mg, B6 400 mg, B12 2 mg, Pantothenic acid 400 mg, Niafcin 1000 mg, Folic acid 1000 mg, Biotin 40 mg.

Statistical analysis. Data were statistically analyzed with analysis of variance (SAS, 1990) with Duncan's multiple range test. T tests were used to compare NH3 levels among treatments.

RESULTS

Experiment 1. Animal performance is shown in Table 3. Average daily gains and feed/gain were significantly improved ($P<0.05$) for all treatments with YE, in-

cluding the spray treatment in replicate 1. These results suggest that, the improved performance was due mainly to effects on air quality rather than to metabolic effects of YE, because similar results with YE were obtained with either dietary addition or spray treatment. The air NH3 levels are shown in Table 4. Trial 1 had begun with a clean facility, so initial NH3 levels were very low. The NH3 levels increased progressively in the control facility, while, with all YE treatments, NH3 levels remained low. The results in replicate 2 showed that the performance was not as good as in the replicate 1. The average daily gain and feed/gain were significantly improved for YE dietary treatments compared to control or YE spray on excreta treatments. YE sprays treatments performance of replicate 2 were not effective and did not differ than the control in all criteria measured in replicate 2. This may be due to the effect of excreta accumulation that surpassed the effect of YE on the odorous gases and NH3 accumulation.

Table 3. Effects of dietary or sprayed-on yucca extract (YE) on rabbit performance and air NH, levels.

Item	Treatment			
	Control	Control+ 125 mg/YE/kg	Control+ 250mg YE/kg	YE sprayed 250mg YE/kg
Replicaate 1				
Avg. daily gain (g)	27.7*	36.0b	36.7b	36.8b
Avg. daily feed intake (g)	126	132	131	125
Feed/gain	4.55*	3.66b	3.57b	3.40b
Mortality (n/24)	1/24	0/24	1/24	0/24
Replicaate 2				
Avg. daily gain (g)	27.7*	33.5b	33.0b	27.7*
Avg. daily feed intake (g)	112	125	126	113
Feed/gain	4.05*	3.72b	3.82b	4.08*
Mortality (n/24)	0	0	0	0

a differs from b ($P<0.05$).

Experiment 2. At 6 weeks of age, birds receiving dietary YE were significantly ($P<0.05$) heavier than control birds. Mortality rate was higher for the control (Table 5). Air NH3 levels were consistently lower with the YE treatment, and were highly significant ($P< 0.01$) at 35 and 42 days.

DISCUSSION

The results indicate that YE could have a useful role in commercial rabbit and poultry production in improving animal performance and air quality. Most commercial rabbitries have poor air quality, with high objectionable NH3 levels. Air quality is frequently poor in poultry houses, the use of YE as a feed additive may present a practice to improve animal performance and welfare.

Table 4. Effects of Yucca Extract (YE) on Air NH3 (PPM) levels: Rabbit experiment.

Days on test	Treatment			
	Control	Control+ 125 mg/YE/kg	Control+ 250mg YE/kg	YE sprayed 250mg YE/kg
Replicaate 1				
7	2.0	1.8	2.0	2.0
14	6.3	10.5	8.0	7.8
21	10.8	9.3	9.5	6.5
35	11.5	16.5	11.0	9.5
40	26.0a	13.8a,b	7.3b	7.0b
50	28.0a	10.0a,b	7.5b	6.5b
Replicaate 2				
1	12.3	9.5	9.5	10.0
10	14.3a	5.8b	8.8	8.5b
15	19.5a	5.5b	7.8b	7.5b

a differs from b ($P<0.05$).

Table 5. Effects of Yucca Extract (YE) on Air NH3 (PPM) levels: Rabbit experiment.

Item	Treatment	
	Control	Control + YE
Final body weight (g)	348.6a	395.2b
Avg. total gain (g)	308.0a	356.1b
Mortality (%)	1.8	0.8
Air NH3 (ppm)		
21 days	3.7	2.1
28 days	8.3	6.6
35 days	14.5c	7.7d
42 days	21.3c	6.7d

a differs from b ($P<0.05$); c differs from d ($p<0.01$).

REFERENCES

1. Bullis, K.L., G.H. Snoeyenbos and H.Van Roekei. 1950. A Keratinconjunctivitis in chickens. Poul. Sci., 29: 386-389.

2. Charles, D.R., and C.G. Payne. 1966. The influence of graded levels of atmospheric Ammonia on chickens. The effect on respiration on the performance of broilers and replacement growin stock. Br. Poul. Sci., 7: 177-187.

3. Goldhaft, T.M. 1969. Adverse effects of ammonia on animals. Intestinal poultry industry exposition. New Orleans. Louisiana, Set. 15-18.

4. Headon, D.R. 1991. Glycofractions of the yucca plant their role in ammonia control. In Biotechnology in the feed industry. Proc. 7th Alltech Symposium, Alltech Technical publications, Nicholasville, KY, pp. 95-108.

5. Ismail, A.M. A.Al-Bar, K.M. Mansour and P.R. Cheeke. 1996a. Evaluation of some probiotic growth promoters on rabbit performance. Ann. Agric. Sci., P. Issue: 71-79.

6. Ismail, A.M., K.M.Mansour, S.M. Siam, A.G. Abdallah and S. Abou-El-Wafa. 1996b. Effects of De-Odorase and Lacto-Sac administration on rabbit performance and some blood constituents. Ann. Agric. Sci., SP. Issue: 81-89.

7. Johnston, N.L., Charles. C.L., Fagerberg D.J., Caveny D.D. 1981. Evaluation of Yucca saponin on broiler performance and Ammonia supperssion. Poul. Sci., 60: 2289-2292.

8. Lyons T.P. and D.R. Headon. 1991. Glyco-components from plants. New tools for controlling pollution. Twenty-sixth Annual Pacific Northwest Animal Nutrition Conference, Beaverton, OR.PP. 277-289.

9. Morrisse, J.P. 1979. Action of an irritant (NH3) on the pathology of a respiratory disease induced experimentally by *Pasteurella multocida* in the rabbit. Ann. Zootech., 28: 139-143.

10. Patton, N.M., H.T. Holmes, D.D. Cavney, M. Matsumoto and P.R. Cheeks. 1980. Experimental inducement of snuffles in rabbits. J. Appl. Rabbit Res., 3 (1): 8-12.

11. Petkov, F. 1966. Effect of increased concentration of ammonia hydrogen sulfide and carbon dioxide on laying hens. Vet-med. Nanki Bot., 3: 351-356.

12. SAS Institute. In., 1990. SAS/STAT Guide for personal computers. Versi.

تأثير التغذية بمادة الديودوراس على أمونيا الجو فى عنابر الدواجن والأرانب وكذلك مظاهر النمو

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اجريت تجربتان إحداهما على الأرانب والأخرى على قطيع من اللجهورن لدراسة اثر التغذية بالديودوراس على امونيا الجو وكذلك مقاييس النمو. وقد أجريت الدراسة فى حجرات متطابقة من حيث مساحتها (٤,٩ متر ، ٤,٩ متر). وتم تجميع مخلفات الأرانب (زبل) على أفرخ بلاستيك مغطاة بنشارة خشب ، وبالنسبة للكتاكيت كانت سمك طبقة النشارة ١٠ سم. قسمت الأرانب فى التجربة الأولى الى ٤ مجموعات وهى الكنترول والكنترول + ١٢٥ مجم ديودوراس /كجم عليقة والثالثة عند مستوى ٢٥٠ كجم/ كجم عليقة والرابعة تم رش الديودوراس على مخلفات الأرانب، وكان هناك ٣ أقفاص مكررة بكل منها ٨ أرانب لكل معاملة.

وكانت مدة التجربة ٥٠ يوما. وتم عمل نفس التجربة مرة أخرى ولكن على مخلفات التجربة الاولى وكانت مدة التجربة الثانية ٣٥ يوما. وقد تم قياس مستوى الامونيا على مستوى ٣٥ سم فوق وتحت القفص فى الأيام التالية : ٧ : ١٤ : ٢١ : ٢٨ : ٣٥ : ٤٠ : ٥٠ وفى الأيام ١ ، ١٠ ، ٣٥ بالنسبة للتجربة الثانية. وبالنسبة لمقاييس النمو وجد أن معدل الزيادة اليومية فى وزن الجسم قد إزداد بوجود الديودوراس مقارنة بالكنترول من ٢٧,٧ جم الى ٣٦,٧ جم وتحسن معدل التحويل الغذائى من ٤,٥٥ الى ٣,٥٧ فى التجربة الأولى بينما كانت النتائج فى التجربة الثانية بالنسبة لزيادة الوزن هى ٢٧,٧ جم للكنترول و ٣٣,٥ جم للمعاملة المضاف إليها الديودوراس وتحسن معدل التحويل من ٤,١٥ الى ٣,٧٢ جم/جم بينما كان مستوى الامونيا فوق وتحت القفص كما يلى ٢٦ ، ٣٠ للكنترول و ١٣,٧ للمعاملة الثانية ، ٦ ، ٩ للمعاملة الثالثة جزء فى المليون وذلك فى اليوم ال ٥٠ من التجربة الأولى. وبالنسبة للتجربة الثانية كان مستوى الامونيا عند اليوم ٣٥ هى ١٥ ، ٢٤ للكنترول ٥ ، ٥,٥ للمعاملة الثانية ٧,٥ ، ٨ للمعاملة الثالثة.

تم استخدام عدد ٢٠٠٠ من كتاكيت اللجهورن فى التجربة الثانية وتم استخدام مستوى ١٢٥ مجم من الديودوراس / كجم عليقة مقارنة بالكنترول وتم قياس مستوى الامونيا أسبوعيا لمدة ٦ أسابيع على ارتفاعات مختلفة هى ٠,٣ ، ٠,٩ ، ١,٥ متر من سطح الأرض وتم تقدير معدلات النمو بوزن ٢٥ طائر من كل حجرة أسبوعيا (٤ حجرات). وكانت النتائج عند الأسبوع السادس كما يلى : متوسط وزن الجسم ٣٤٩ جم للكنترول و ٣٩٥ جم لمجموعة الديودوراس بينما كان مستوى الامونيا فى الجو ٢١,٣ للكنترول يقابلها ٦,٧ جزء فى المليون لمجموعة الديودوراس. ومن هنا يمكن القول بأن التغذية بالديودوراس قللت من الامونيا بجو العنابر وزادت من معدلات النمو وحسنت من كفاءة التحويل الغذائية.